4 FIELD INVESTIGATION APPROACH

This section presents the sampling design and rationale for a tiered approach to complete the Park RI field investigation (Figure 4-1). The design is based on an understanding of historical site data and best professional judgment. Specific issues related to sampling methods and sample handling procedures are addressed in Sections 5. Laboratory methodology and QA/QC procedures are presented in the accompanying QAPP.

Visual, sheen, and headspace screening will be conducted in the field on all soil and sediment samples collected during this investigation. Visual screening will consist of inspecting the soil/sediment for the presence of stains indicative of residual petroleum hydrocarbons. Sheen testing will involve immersion of a portion of the soil/sediment sample in water and observing the water surface for signs of petroleum sheen. Headspace screening will involve the semi-quantitative measurement of total volatile compounds in the air above the sample material using either a flame ionization detector (FID) or photo ionization detector (PID). This field screening approach will assist in selecting samples for laboratory analysis and provide real-time information on whether the proposed sampling program should be expanded to include the collection of additional samples at depth and/or at surrounding locations to further evaluate the nature and extent of contamination at the site.

Metals will be analyzed in all samples because several metals have commonly exceeded their SLs in samples from previous investigations throughout the Park. Chlorinated pesticides and PCBs will be analyzed only in soil samples from the BNSF, because this is the only area where pesticides/PCBs are expected to be present. No samples are proposed for analysis of VOCs because very few VOCs have exceeded their SLs in samples from previous investigations and because historical operations in the Park do not support significant VOC contamination. However, results from the headspace screening in the field may be followed by the laboratory analysis of samples for VOCs if it is deemed warranted.

There are two different laboratory methods of analysis for petroleum hydrocarbons. The NWTPH method provides one result with broad coverage of both aliphatic and aromatic GRO components (NWTPH-Gx) and DRO components (NWTPH-Dx). The petroleum mixture can also be fractionated into smaller carbon chain ranges, treating aliphatics and aromatics separately, to provide more comprehensive information on the composition of the mixture.[13] Fractionation data are necessary to calculate site-specific petroleum cleanup levels, rather than relying on default cleanup levels. GRO mixtures can be fractionated using the VPH analysis. DRO mixtures can be fractionated using the EPH analysis.

[13] For soil and sediment samples, a silica gel cleanup can be used to remove natural organics before analysis.

VPH and EPH analyses are considerably more expensive than the NWTPH analysis. The extra expense of VPH/EPH analyses is unnecessary if the concentrations of petroleum in the sample are low or undetected. The soil and sediment samples will be analyzed initially using the NWTPH method, requesting the GRO analysis, the DRO analysis, or both depending on historical practices in the area. Only those soil and sediment samples that yield detected GRO/DRO results above the SL (100/200 mg/kg for soil and 50 mg/kg for sediment[14]) will be considered for fractionation analyses. In some cases, not all of the samples with GRO/DRO results above the SLs will be submitted for fractionation. Best professional judgment will be used based on the number of samples with GRO/DRO results above the SLs in an area and an understanding of historical practices, which would indicate how heterogeneous or homogeneous the petroleum compositions are likely to be in that area. If homogeneous compositions are expected, fewer samples will be selected for fractionation. When a sample is selected for fractionation, it will be analyzed by VPH if GRO was detected, by EPH if DRO was detected, or by both VPH and EPH if both GRO and DRO were detected above the corresponding SL.

Surface water and groundwater samples will be analyzed initially using the NWTPH method. Best professional judgment will be used in analyzing groundwater and surface water samples for VPH, EPH, or both as appropriate.

A few SVOCs have commonly exceeded their SLs in surface water, soil and sediment samples from previous investigations. The SVOCs of primary concern are PCP (from wood-treating operations), PAHs (components of petroleum and creosote), and phthalates (common in urban runoff). The NWTPH analysis can act as a screen for the SVOCs of concern, because PAHs are components of petroleum and because PCP and phthalates are expected to be co-located with petroleum to some degree. Soil and sediment samples for possible SVOC analyses will be archived, selecting for SVOC analysis those samples with detected GRO or DRO results above their SLs. A minimum of 20% of the soil and sediment samples will be analyzed for SVOCs, even if GRO and DRO are detected (or below the SL) in fewer than 20 percent of the samples. Because of the limited number of surface water and groundwater samples proposed, all of the samples will be analyzed for SVOCs.

Dioxin/furan analyses are substantially more expensive than the other analyses, so only select samples will be analyzed for these chemicals. Surface water samples collected at SW05 (representative of the OESER outfall), SW06 (representative of the Birchwood neighborhood) and background locations will be analyzed for dioxins and furans. No other surface water samples are planned for this testing. All groundwater samples will be

[14] The MTCA Ecology Indicators for Soil Biota of 100 mg/kg (GRO) and 200 mg/kg (DRO) are the proposed SLs for NWTPH in soils in the Park. Based on discussions with Ecology, a lower SL of 50 mg/kg for GRO/DRO will be used for sediments. Samples exceeding 100/200 mg/kg and 50 mg/kg over reference or background levels will be analyzed for SVOCs in soils and sediments, respectively.

analyzed for dioxins and furans. Soil and sediment samples will be archived for possible dioxin/furan analyses, selecting for dioxin/furan analysis those samples with detected concentrations of PCP above its SL (0.360 mg/kg[15]).

The testing program for soils/sediment will consist of four tiers. The first tier is field screening for all collected samples. The second tier is the NWTPH analysis. A GRO or DRO result above its SL invokes the third tier, which is the SVOC analysis, which includes PCP, and possibly also VPH/EPH analyses. A PCP result above the SL invokes the fourth tier, which is the dioxin/furan analysis.

Throughout the tiered approach for analyzing archived samples, best professional judgment and common sense will dictate the choices of analyses. The goal is to improve the understanding of the nature and extent of contamination in the Park with the most cost-effective sampling and analytical strategy possible, not merely to adhere to a strictly proscribed protocol. Any deviations from the protocol described here will be made only with Ecology approval and documented with explanation.

Background or reference samples will be collected for each of the media planned for sampling in the Park (i.e., soils, groundwater, surface water, sediments). The background location for groundwater is a well located northeast of the OESER site near Cedarwood Avenue (MW-06D). The reference location for soils[16], surface water, and sediment is planned for a tributary of Whatcom Creek with similar characteristics as Little Squalicum Creek (an acceptable background location was not identified up-gradient of the project site). Selected reference locations must be upstream of any point sources (including the burn area of Whatcom Creek) and only be impacted by local stormwater runoff. The locations being considered include:

- Fever Creek near Roosevelt Park or north of Alabama Street
- Cemetery Creek near or within Bayview Cemetery.

More than one reference sample may be required to match varied physical characteristics (e.g., grain size) of the Park soil, surface water, and sediment samples.

[15] The Ecology SQS for Marine Sediments is the proposed SL for pentachlorophenol in soils and sediments in the Park. Samples exceeding 0.360 mg/kg pentachlorophenol will be analyzed for dioxins.
[16] A total of 20 background soil samples were collected during the OESER RI. These samples will also be used for comparison to soil samples collected during this RI.

4.1 SOIL INVESTIGATION

4.1.1 Rationale

The primary goal of soil sampling is to fill in spatial data gaps at the gravel pit and BTC areas, which are not suspected of having high contaminant concentrations, and in the BNSF right-of-way. The sampling pattern will be approximately evenly spaced to provide broad coverage of these areas, with an equal likelihood of finding contamination throughout the areas. To make the most efficient use of budget, a tiered analytical approach will be used.

4.1.2 Sampling Strategy

The investigation will include the excavation of 12 test pits (TP), distributed as follows (Figure 4-2):

- TP-1 through TP-3 will be located in the southeast area of the Park near BTC
- TP-4 will be located on the east side of the Creek, north of the area where the underground stormwater pipeline enters the Creek
- TP-5 through TP-8 will be located south(east) of the Creek and east of Marine Drive in the area of the historical gravel pit operations
- TP-9 through TP-12 will be located south(east) of the Creek and west of Marine Drive in the area of the historical gravel pit operations.

The test pits will allow the collection of soil samples at depth in the areas of historical landfill and gravel pit operations, which might have disturbed soils and distributed contamination throughout a depth range up to several feet. Furthermore, TP-9 through TP-12 are located in areas considered for possible re-routing of the Creek (refer to Figure 1-1 in the Work Plan), and it is advisable to have chemical and physical soil data at depth in these locations. In each test pit, all samples will be screened in the field for petroleum hydrocarbons. A sample collected from surface to 1 ft bgs will be submitted for analyses. Additional samples will be collected at 1-2 ft bgs, 2-3 ft bgs, and the bottom of the test pit for archiving. The tiered approach for analyzing these samples is discussed in Section 4.1.3.

Using a hand auger,[17] nine locations will be investigated, as follows (Figure 4-2):

[17] A hand shovel or equivalent may be used if coarse soils are encountered prohibiting the use of the hand auger.

- HA-1 through HA-6 will be located along the BNSF right-of-way
- HA-7 and HA-8 will be located northeast of the Creek in an area suspected to be impacted by a historical OESER spill or contaminated runoff
- Background locations planned for a Whatcom Creek tributary (either Fever Creek near Roosevelt Park or Cemetery Creek near Bayview Cemetery).

Hand augering is proposed for these locations because it is less intrusive than test pits. Samples will be collected at 0-1 ft bgs and 1-2 ft bgs and screened in the field for petroleum hydrocarbons. The tiered approach for analyzing these samples is discussed in Section 4.1.3.

Piezometers will be installed at three test pit locations (TP-3, TP-6, TP-12) to monitor seasonal changes in groundwater levels within the Park. Test pits may have to be excavated deeper, depending on time of year, to observe groundwater seepage at these locations. The depth and seasonal fluctuations in shallow groundwater will be important to understand if the creek is rerouted to other areas of the park.

4.1.3 Analytical Strategy

Reference sample(s) will be analyzed for metals, GRO, DRO, pesticides/PCBs, SVOCs, and dioxins/furans and a sample will be archived for possible VPH/EPH analysis, if necessary.

Field screening results will be considered in the selection of soil samples for analysis. For planning purposes, 0-1 ft site samples from test pit and hand auger locations will be analyzed for the following chemical classes (refer to Table 4-1):

- Metals (all surface samples)
- NWTPH-GRO (some surface samples) and -DRO (all surface samples)
- Pesticides and PCBs (by the BNSF only)
- TOC (all surface samples)
- Physical testing including grain size, moisture content, specific gravity, bulk density, Atterburg Limits (if sample is primarily fine grained) (all surface samples/0-1 ft samples and 2-3 ft samples).

DRO analyses will be requested for all surface soil samples (0-1 ft). GRO analyses will also be requested for the following sample locations, which are most likely to be impacted by urban runoff containing GRO:

- TP-1 through TP-3 near BTC
- TP-9 near the Marine Drive Bridge.

Site surface soil samples (0-1 ft bgs) will be archived for possible VPH, EPH, SVOC, and dioxin/furan analyses, depending on the GRO/DRO results. For each 0-1 ft sample, if the GRO or DRO result exceeds its SL, an archived sample from the same location will be analyzed for SVOCs. If PCP is detected above its SL, the archived sample from the same location will be analyzed for dioxins/furans. If the GRO/DRO result exceeds the SL, an archived sample may be selected for VPH/EPH analysis, depending on the results of other samples from the same area and using the professional judgment discussed previously.

If any chemical exceeding its SL is detected in the 0-1 ft sample of a test pit or hand auger, the lab will be requested to analyze the archived 1-2 ft sample from that location for the appropriate chemical class. If the chemical exceeds its SL in the 1-2 ft sample, the lab will be requested to analyze the archived 2-3 ft sample (test pits only). Finally, if the chemical exceeds its SL in the 2-3 ft test pit sample, the lab will analyze the archived sample from the bottom of the test pit.

If the decision logic described above results in the selection of fewer than 20% of the site surface soil samples for SVOC analyses, additional samples will be selected for SVOCs until a minimum of 20% of the soil samples is reached. The selection of additional samples will rely on best professional judgment, with an effort to select samples from each of the three areas under investigation (BNSF, gravel pit, BTC).

This is a hypothetical example of the tiered soil testing program (all soil samples are screened in the field for petroleum hydrocarbons).

> Lead, cadmium, GRO, and DRO are detected above their SLs in the 0-1 ft sample from TP-6. The lab is requested to analyze an archived 0-1 ft sample from TP-6 for SVOCs and an archived 0-1 ft sample for VPH and EPH. PCP is detected by the SVOC analysis above a concentration of 0.360 mg/kg, so the lab is asked to analyze the archived 0-1 ft sample for dioxins/furans, which are detected.
>
> Based on the results of the 0-1 ft sample, the lab is requested to analyze an archived 1-2 ft sample from TP-6 for metals, GRO, DRO, and SVOCs. Lead and DRO are detected above their SLs in the 1-2 ft sample, but GRO and PCP are not detected above their SLs. The lab is then asked to analyze the archived 1-2 ft sample for EPH, but not VPH. Since PCP was not detected, the lab is not asked to perform a dioxin/furan analysis.
>
> Based on the results of the 1-2 ft sample, the lab is requested to analyze an archived 2-3 ft sample for metals and DRO. Lead is detected above its SL, but DRO is not. The lab is asked to analyze an archived sample from the bottom of the test pit for metals only.

4.2 GROUNDWATER INVESTIGATION

4.2.1 Rationale

The primary goal of groundwater sampling is to update existing data. The sampling pattern will focus on wells located downgradient from the OESER site that are potential sources of contamination to the creek.

4.2.2 Sampling Strategy

Integral will collect two rounds of groundwater samples (GW), one during the wet season and one during the dry season. The wet season samples will be collected between November and May, while the dry season samples will be collected between July and October. The sampling will be conducted at the following times:

- Dry season (September/October 2005)
- Wet season (December 2005/January 2006).

The following four groundwater well locations will be sampled (Figure 4-3):

- MWLSC01 through MWLSC03 (located on the old railroad grade north of the creek and downgradient of the OESER site)
- MW-06D (Background well located northeast of OESER site).

These sampling locations have been sampled previously and are representative of potential sources of contamination to the creek. Sediment/soil sampling (refer to Section 4.4) will also be used to evaluate potential groundwater impacts adjacent to the creek. Results of that evaluation along with this well data will be used to develop a more complete CSM of area groundwater.

4.2.3 Analytical Strategy

All groundwater samples from the site and the background location will be analyzed for hardness, total suspended solids (TSS), TOC, metals (including calcium and magnesium), NWTPH-GRO/DRO, SVOCs, and dioxins/furans, and a sample will be archived for possible VPH/EPH analysis (refer to Table 4-2).

4.3 SURFACE WATER INVESTIGATION

4.3.1 Rationale

The primary goal of surface water sampling is to update existing data. The sampling pattern will focus on the discharge points to the Creek that are potential sources of contamination to the creek. Sampling will focus on the wet season rather than the dry season, since surface water contamination is more likely to be encountered during the wet season based on historical data (E&E 2002a).

4.3.2 Sampling Strategy

Integral will collect two rounds of surface water samples (SW), both during the wet season. The wet season samples will be collected between November and May. The sampling will be conducted at the following times:

- Beginning wet season (November/December 2005)
- Wet season (January/February 2006).

The following seven surface water locations will be sampled (Figure 4-3):

- SW01 (downgradient of all discharge points to the Creek)
- SW04 (potential discharge point from Marine Drive to the Creek)
- SW05 (discharge point from OESER to the Creek)
- SW06 (discharge point from BTC to the Creek)
- SW07 (near BTC)
- SW09 (spatial representation between Marine Drive bridge and BNSF Railroad bridge)
- Reference location planned for a Whatcom Creek tributary (either Fever Creek near Roosevelt Park or Cemetery Creek near Bayview Cemetery).

These sampling locations have been sampled previously and are representative of potential sources of contamination to the creek.

4.3.3 Analytical Strategy

The surface water samples collected from the OESER outfall (SW05), Birchwood neighborhood (SW06), and the reference location will be analyzed for hardness, TSS, TOC, metals (including calcium and magnesium), NWTPH-GRO/DRO, SVOCs, and dioxins/furans, and a sample will be archived for possible VPH/EPH analysis (refer to Table 4-2). Other surface water samples will be analyzed for hardness, TSS, TOC, metals, NWTPH-GRO/DRO, and SVOCs, and samples will be archived for potential VPH/EPH. If GRO/DRO are detected above their SLs, an archived sample from the same location will be analyzed for VPH, EPH, or both as appropriate.

4.4 SEDIMENT INVESTIGATION

4.4.1 Rationale

The primary goal of sediment sampling is to define the extent of hot spots detected during previous investigations (i.e., Ecology study) and to define the width and depth of contamination in the Creek including the identification of SQS and CSL cleanup boundaries. The sampling pattern will focus on bounding contaminated areas identified in previous investigations and performing transects across the creek. To make the most efficient use of budget, Integral will use a tiered analytical approach similar to the one described above for soil.

4.4.2 Sampling Strategy

Integral will collect surface sediment samples (0-4 inches [0-10 cm] bgs) from the following seven locations (Figure 4-4):

- LSC07
- LSC08
- LSC09
- LSC10 through LSC12 on the beach but within the discharge area of the Creek
- Reference location planned for a Whatcom Creek tributary (either Fever Creek near Roosevelt Park or Cemetery Creek near Bayview Cemetery).

These sample locations will assist in defining the boundaries of a hot spot identified upstream of these locations during the Ecology investigation (Ecology 2004) and verifying that the beach does not pose a health threat.

After surface samples have been collected, transects will be performed across the creek bed in the following six locations, evenly spaced over the length of this portion of the creek, using a track-mounted, portable, hollow stem auger to collect samples at depth (Figure 4-4):

- Near LSC04, immediately downstream of the OESER and BTC discharge points
- Near LSC07, midway downstream between the OESER and BTC discharges and the Marine Drive Bridge
- Near LSC08, at the lower end of this creek section
- Near LSC09, downstream of the Marine Drive bridge
- Near LSC03, midway downstream between the Marine Drive bridge and BNSF railroad bridge
- Near LSC01, just upstream of the BNSF railroad bridge.

Transects will allow Integral to investigate the depth and width of sediment contamination in this portion of the creek. Sediment/soil sampling will also be used to evaluate potential groundwater impacts to the creek. For example, borings located upgradient of the creek that show the presence of contamination would support groundwater as a pathway to the creek.

In the event sediment/soil samples are not collected from a proposed location(s) due to refusal (e.g., too gravelly), a temporary well may be installed to evaluate groundwater impacts at this location(s).

For each transect upstream of the Marine Drive bridge, sediment samples will be collected from 0-1 ft bgs, 1-2 ft, 2-3 ft bgs, 3-4 ft bgs, and 4-5 ft bgs at three individual locations as follows:

- A central location midstream
- 5-10 ft south of midstream at or near the stream bank
- 5-10 ft north of midstream at or near the stream bank.

For each transect downstream of the Marine Drive bridge, sediment samples will be collected from 0-1 ft bgs, 1-2 ft, 2-3 ft bgs, 3-4 ft bgs, and 4-5 ft bgs at five individual locations as follows:

- A central location midstream
- 5-10 ft south of midstream at or near the stream bank
- 25-30 ft south of midstream on the stream bank
- 5-10 ft north of midstream at or near the stream bank
- 25-30 ft north of midstream on the stream bank.

Fewer borings are planned for the upstream transects because this area of the creek is confined to a narrower and in some places steeper channel. The channel widens downstream past the Marine Drive Bridge.

Samples may be collected deeper than 5 ft bgs based on observations made in the field (i.e., field screening for visual contamination and headspace analysis).

4.4.3 Analytical Strategy

The analytical strategy for sediment samples will be similar to the analytical strategy for soil samples. The reference sample(s) will be analyzed for TOC, total sulfides, ammonia, metals, DRO, SVOCs, and dioxins/furans, and a sample will be archived for possible EPH analysis. Field screening results will be considered in the selection of site sediment samples for analysis. For planning purposes, all site surface (0-10 cm) and the 0-1 ft and 1-2 ft boring sediment samples will be analyzed for the following chemical classes (refer to Table 4-3):

- TOC
- Metals
- NWTPH-DRO.

Surface sediments (0-10cm) will also be analyzed for total sulfides and ammonia to assist in evaluating the bioassay tests. GRO will not be analyzed, as light end hydrocarbons are not expected to remain in the stream sediments. However, field screening results will be considered in the possible analysis of GRO and VOCs in some samples. Physical testing will also be analyzed for the surface (0-10cm), and 0-1 ft and 2-3 ft samples at depth from selected borings representative of each transect.

Site surface (0-10 cm), 0-1 ft, and 1-2 ft sediment samples will be archived for possible EPH, SVOC, and dioxin/furan analyses, depending on the DRO results. For each site surface or 0-1/1-2 ft sediment sample, if the DRO result exceeds its SL, an archived sample from the same depth will be analyzed for SVOCs. If PCP is detected above its SL, an archived sample from the same location will be analyzed for dioxins/furans. If the DRO result exceeds its SL, an archived sample may be selected for EPH analysis, depending on the results of other samples from the same area and using the professional judgment discussed in Section 4.2.

If any chemical exceeding its SL is detected in the 1-2 ft sediment sample of a transect location, the lab will be requested to analyze the archived 2-3 ft sample from the same

transect location for the appropriate chemical class. If the chemical exceeds its SL in the 2-3 ft sample, the lab will be requested to analyze the archived 3-4 ft sample, and so on. If the decision logic described above results in the selection of fewer than 20% of the site sediment samples for SVOC analyses, additional samples for SVOCs will be selected until a minimum of 20% of the samples for confirmation purposes is reached. The selection of additional samples will rely on best professional judgment, with an effort to select samples throughout the length and breadth of the creek.

Based on the chemical results of the surface sediment samples, toxicity testing will be performed at those locations where concentrations exceed SLs. The proposed tests are:

- Amphipod (*Hyalella azteca*) 10-day mortality test (USEPA 2000b; Test Method 100.1)
- Microtox® Sediment Porewater (*Vibrio fischeri*) (Ecology 2003)
- Midge (*Chironomus tentans*) 20-day mortality and growth test (USEPA 2000b; Test Method 100.2 modified).

Sediment for toxicity testing may be stored in the dark for a maximum of up to eight weeks. Sample bottles will be stored either with no headspace or headspace purged with nitrogen gas.

4.5 SHELL MIDDEN BOUNDARY SURVEY

One prehistoric archaeological site (shell midden) has been identified in the Creek ravine and it is possible that additional sites could also be present (Figure 2-1). The presence of a potentially significant archaeological site requires that cultural resources be addressed before starting any intrusive sampling activities (e.g., test pit excavations). These resources will be addressed using a staged approach. The cultural resource management activities planned for the Park RI/FS may have as many as three stages: 1) inventory of impact areas, 2) evaluation of the identified resources, and 3) development and implementation of a management plan.

The first effort will be to inventory the area by a trained archaeologist/anthropologist. This effort will determine whether, and where, archaeological deposits are present. As noted, at least one site is known to be present. The presence of this site will be confirmed, and its boundaries will be determined and recorded. Other portions of the Park will also be investigated, and, if additional archaeological sites are located, they will also be mapped and recorded. The inventory effort will be accomplished using a combination of background research, and direct archaeological survey inspection, including the use of limited subsurface testing. Once the distribution of archaeological deposits in the project area is determined, it will be possible to assess whether any of these deposits are threatened by the planned environmental assessments and subsequent park developments.

If it appears that an archaeological site is threatened, it will be necessary to determine that site's eligibility for listing with the National Register of Historic Places. A small-scale test excavation will be needed in order to perform this evaluation. If more than one site in the Park is threatened by this project, multiple evaluations will need to be conducted. If a threatened archaeological site is shown to be eligible for listing with the National Register of Historic Places, a management plan will be developed. The plan will seek to avoid or minimize damage to the site. Avoidance is always the preferred protection option, but this is not always possible. If avoiding damage to a site eligible for the National Register is not possible, it may be necessary to undertake data recovery excavations in order to document the cultural deposits that will be destroyed. The management plan could also address protection and interpretation of the site in the future park if this is desirable.

An inventory of the shell midden and other archaeological sites (if found) is planned for fall 2005, before fieldwork for the RI commences. The archaeological inventory will be conducted by Dr. Gary Wessen of Wessen & Associates, Inc., with the assistance of technical support personnel provided by the Lummi Indian Nation's Cultural Contract Services Department. Dr. Wessen will undertake the background literature review and together with the Lummi technical staff, will conduct the fieldwork. The boundaries of each site will be staked and surveyed. All intrusive activities will be avoided within these boundaries.

4.6 FIELD QC SAMPLES

Field duplicates will be collected periodically throughout the sampling program at a frequency of 1 per 20 field samples. Equipment rinse blanks will be collected once for each type of collection method (i.e., surface sediment, groundwater, borings, test pits, surface water). Refer to Section 5 for field QC sampling procedures.